Full transcript of Interviews with Experts

Pete Schultz (PS): It's fun just to think about what you can do with these types of devices.

Erica Jawin (EJ): The sort of organic, biosynthetic technology that you're developing here has incredible applications.

JH: Going from fly-bys, to orbiters, to landers, to rovers, to human exploration, is completely increasingly complexity, which things like origami concepts could help with in all dimensions. Saving Mass, Volume, and Time.

EJ: We've been restricted a lot by space, by mass.

JH: Up-mass to Mars is a huge problem and you want to have as much available.

Lauren Jozwiak (LJ): One of the biggest constraints in any space mission is up-mass. It is the guiding thing from principle design all the way through final mission, and it really controls what you can and cannot take with you on the mission, and instruments have been cut in the past because of up-mass. So if you have the ability to save space, to save mass, in any way, via your origami, you open up a whole new world of possibilities of what you can take. You can take more instruments, you can do more science, and you can utilize your missions in better ways and ultimately save more money because you are being more efficient with your space and that's really, really a key thing.

JH: When I worked in astronaut training in Apollo, the problem we had was that there's a huge amount of time in which the astronauts aren't looking around at the geology, but are actually just doing tasks, which are important to do, but if you could figure out a way to free them from that by using these unfolding and self-folding origami type technologies, so to speak, then that would be amazing because Dave Scott, the Apollo 15 commander said, "We gotta work on this, we gotta work on this, because if we can free us up, we can just go twice as far, do all these different things, and really understand the geology better."

Idea 1: Robots and Rovers

JH: So, this is a great principle to apply to robotic spacecraft, particularly I think rovers and deploying rovers, on the moon, on Mars, and other planetary bodies as well.

EJ: The issue with a lot of the rovers, for example, that are deployed on the surface of Mars, like the Mars Exploration rovers, and the Mars Science Laboratory, is they have a lot of moving parts. So for example, the Mars exploration rovers have solar panels, that once it lands, the rover has to deploy, and open, and then tilt towards the sun.

JH: Sometimes the arms fold out like this to reveal the rover, other times you have to do this like, airbags have to be mechanically retracted, etc.

EJ: But the more moving parts you have, the more easily something could break. If you can deploy some sort of self-folding origami, that can just open once and then be stationary, that's a lot fewer parts that can actually malfunction.

JH: If you could make them work in such a way that they compress themselves or opened up themselves, it would save a huge amount of up-mass, and down-mass, and also time.

EJ: And the rover can have a much longer lifetime potentially.

Idea 2: Structures and Sensors for Precursor Missions

JH: Origami approaches, both compressing and opening up, would be really applicable to precursor missions where you would send supplies and other things that would be able to be constructed robotically so that you have done a huge amount of the work for the infrastructure before the humans got there.

EJ: And so you could deploy tons of metal and building materials, and have rovers build a habitat over years, or you could just send a piece of self-folding origami that can, with a little bit of an electric charge, just construct itself, and then have humans just drive up to this habitat and walk in and immediately start doing science. That makes a huge difference by itself.

JH: When we explore the planets, one of the things we really want to understand, for Mars, for example, is the weather. If we're going to send humans there, you need to know microenvironments, not just the general planetary environment. So you want to deploy spacecraft, small spacecraft that have these sensors on them, as many places as you can. And that means you have a huge amount of mass, for a large number of these things so make them simple, and self-operating, like fold them up very tightly so you can send hundreds, maybe thousands of them, and then have them open up and operate by themselves to reveal solar panels or other sensors. This would be great.

Brainstorming More Ideas: Objects, Medical Devices, Habitats

PS: There are a lot of devices you could use that would fold up using these biologically-constructed materials. I've thought about a couple of them. One of them is for example, in the space station for shelter, or privacy. Let's talk about privacy first. I know that you're in an enclosed area for a long time, but sometimes you'd just like to be alone. So if you could devise something that would simply fold up, unfold, and then fold up to be able to create this privacy space, that would really be a handy thing that I could imagine.

LJ: There are actually deposits of water ice, hydroxyl, in the shallow subsurface, we're talking the upper centimeters of the moon, at the poles, in these regions that never see sunlight. You could send up some sort of condenser tent over these permanently shadowed regions, harvest the water, fold around the water, and now you've got a cup full of this lunar water for use for the astronauts for whatever they needed, for fuel, for hydration.

PS: I can imagine habitats. I can imagine shelters. I can imagine them as partitions. I can imagine them any place where it's confined, any place where you really want to have simple materials that you want to use the Earth or some other source that you already have there.

EJ: So if you can create some sort of habitat that could unfold itself like origami and create a habitable environment for humans, that could protect them from these global dust storms that you have. This could protect them and provide some radiation shielding. It could provide a thermal buffer and could create an atmosphere that humans could breathe, unlike the carbon dioxide atmosphere that's present on the surface of Mars.

PS: Something that would flex and relax, flex and relax, you could turn it turn it into a focusable lens, just like the eye works by having muscles that pull, changes the focal length, you could do the same thing if you had them rimming a lens that was flexible. And that could be used for adjustment. You could use it to adjust, say, for example, you want to increase the energy that would go into a spot from the sun, and suddenly you have fire. Or, if it's something just to focus at different times, for a rapid focusing device.

PS: I can also picture using one of these things in a slightly different way. The type of devices that would expand and contract depending on temperature. I thought, wouldn't that be cool to put this into a bird? Something that could adjust, very similar to the way the Wright brothers used to do it with their feet and hands, to adjust the aerodynamics of the wings?

EJ: What sort of implications does your self-folding have for backpackers? And any kind of space-saving technology that we can develop is going to have these sort of spin-off benefits that will pervade their way into everyday life, not just exploration or space travel, but you know, backpackers, or for surgeons, or, I don't know, anything.

PS: So there's some devices that actually fold up like that, so it's really interesting to think that these things could actually fold up in sequence and actually begin to walk across the moon.

PS: I'm picking up samples, and you know the sample containers take up a lot of space, so it would be really interesting to have something that would be different sizes of samples – things that would be flat but then turned into something that would then occupy space with the sample. That would be something very valuable.

PS: So I think of some other things you could use, they're flexible devices. You could put them around a leg, for example, or an arm, as a splint, a rapid split, that would simply contract and hold it in place. But you could keep it in a very compact first aid kit.

PS: This is not rocket science here, these are just random thoughts. But anything else, I mean, this is just… right now it blows my mind.